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March 19, 2015

Notice of Ex Parte

Ms. Marlene H. Dortch
Secretary
Federal Communications Commission
445 12th Street SW
Washington, DC 20554

**Re: Notice of Ex Parte Communication
(CC Docket No. 95-116; WC Docket No. 09-109)**

Dear Ms. Dortch:

On March 17, 2015, Jerry James, Consultant to the LNP Alliance¹ and the undersigned met separately with: Commissioner Ajit Pai and Nick Degani, his Legal Advisor; Commissioner Michael O’Rielly and Amy Bender, his Legal Advisor; and Daniel Alvarez, Legal Advisor to Chairman Wheeler, Lisa Gelb, Assistant Bureau Chief, Wireline Competition Bureau (“WCB”), Ann Stevens, Deputy Division Chief, Wireline Competition Division, WCB, and David Simpson, Bureau Chief, Public Safety and Homeland Security Bureau. The LNP Alliance’s technical consultant David J. Malfara, Jr. joined the latter meeting by telephone.²

The LNP Alliance continued to urge the Commission to extend the current Neustar contract and to postpone the vote on the Local Number Portability Administrator (“LNPA”) selection in order to ensure that critical issues, including neutrality, the treatment of ENUM services, and transition costs for small and medium-sized carriers, are publicly and comprehensively addressed in this proceeding. If the Commission proceeds to vote on this item at next week’s March 26 open meeting, the LNP Alliance has recommended a series of

¹ The LNP Alliance is a consortium of small and medium-sized (“S/M”) providers that currently consists of Comspan Communications, Inc., Telnet Worldwide, Inc., the Northwest Telecommunications Association (“NWTa”), and the Michigan Internet and Telecommunications Alliance (“MITA”). The LNP Alliance is focused on ensuring that the LNPA selection process takes into account the concerns of its S/M provider members and other similarly situated providers.

² In the meetings, the LNP Alliance relied upon the powerpoint presentation attached hereto as Exhibit A.

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conditions that the Commission should impose on the next LNPA. *See* List of LNP Alliance Proposed Conditions on Telcordia Contract Award, attached hereto as Exhibit B.

The LNP Alliance emphasized that the Commission should require that all information necessary to successfully route and establish a session (*e.g.*, a telephone call) in native format to a ported number is wholly and completely contained within the NPAC database record for that number, regardless of whether service for the number is provided using TDM or IP technology. This would eliminate the possibility that non-neutral ENUM registries would impose unforeseen costs and/or processes on smaller carriers. Ensuring that routing and porting data is not stored in non-neutral ENUM registries is particularly critical if Telcordia is awarded the LNPA contract. As the LNP Alliance has highlighted in the past,³ a May 2014 Telcordia White Paper, attached hereto as Exhibit C, demonstrates that Telcordia continues to maintain a vision that the NPAC will play an increasingly diminishing role in number porting and routing with the ascendancy of private, proprietary registries.⁴ Telcordia's historical and ongoing view that the NPAC's role should be eclipsed by private registries reinforces the LNP Alliance concern that the Commission should confirm that all information necessary for the routing and porting of both TDM and IP services must be included in the NPAC.

The LNP Alliance also emphasized that there is no substitute for requiring Ericsson to spin off Telcordia and completely separate Telcordia from its telecommunications equipment provider parent. Spinning off Telcordia is necessary to ensure that the LNPA is not affiliated with a telecommunications provider and aligned with the wireless industry segment in violation of the Commission's rules.⁵ The Commission appears to be proposing a voting trust as an ostensible solution to Telcordia's neutrality problem but continues to fail to provide any meaningful public information on that proposal. The RFP process was designed such that a bidding company would provide a detailed proposal to cure any neutrality issues in its Request for Proposal responses. The reason for this was so that such proposals could be evaluated

³ *See* Comments of the LNP Alliance, WC Docket No. 09-109, WC Docket No. 07-149, CC Docket No. 95-116 (Jul. 25, 2014) ("LNP Alliance Comments").

⁴ iconectiv White Paper, IP Inter-Carrier Routing, Capabilities To Support IP Services Interconnection (May 2014), attached hereto as Exhibit C.

⁵ 47 C.F.R. § 52.26(a) (prohibiting the LNPA from affiliation with a telecom equipment manufacturer); 47 C.F.R. § 52.12(a)(1) (prohibiting the LNPA from being aligned with a particular industry segment); 47 C.F.R. § 52.12(a)(1) (the LNPA must be impartial); 47 C.F.R. § 52.21(k) (the LNPA must be independent); 47 C.F.R. § 52.21(a)(1)(iii) (the LNPA must not be subject to undue influence); *see also* 47 U.S.C. 251(e).

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publicly.⁶ The LNPA selection directly affects every carrier and, as such, the process was designed to have the neutrality solutions aired in a transparent, public process. That has not been the case.

On February 5, 2015, Telcordia met with senior Commission Staff to discuss “instituting a voting trust for *a portion of* Ericsson’s interest in Telcordia”⁷ In our meetings, we were still unable to find out how many board members there would be on Telcordia’s board or what portion of Telcordia’s board would be represented by the voting trust. More importantly, we understand that the voting trust will control shares and occupy board seats at the Telcordia board level. Yet Telcordia is still a wholly owned subsidiary of Ericsson and subject to the whims of the parent company. Importantly, Ericsson will determine the budget and finances of its wholly owned subsidiary, and will continue to maintain control over critical decisions such as mergers, acquisitions, and when to encumber Telcordia’s assets with debt. These parent-level decisions will have a continual undue influence on Telcordia, and the voting trust trustee(s) will have nothing to say about them.

Commission precedent does not support the use of voting trusts in circumstances such as these. The *Warburg Pincus* order is inapposite because in that instance Neustar was not a wholly owned subsidiary of another company.⁸ The Board that the voting trust participated in was the Neustar board. In the case of Telcordia, nothing is being done with respect to the Ericsson board which will continue to control the all-important purse strings and pull additional levers of influence over Telcordia. In addition, Warburg Pincus was an investment company that happened to own interests in telecommunications providers, not like Ericsson a telecommunications equipment manufacturer that was actively running the networks of two of the four major wireless carriers.

More importantly, the Commission has since established that voting trusts are not appropriate in these circumstances. In an order confirming certain restructuring of Neustar, the Commission clarified that:

⁶ The initial Telcordia neutrality proposal, having a separate Telcordia board of directors, was roundly criticized by the LNP Alliance and other commenters as an ineffective solution.

⁷ Letter from John T. Nakahata, Harris, Wiltshire & Grannis LLP to Ms. Marlene H. Dortch, Secretary, FCC, CC Docket No. 95-116, WC Docket No. 07-149, and WC Docket No. 09-109, at 1 (Feb. 9, 2015) (“Telcordia Ex Parte Letter”).

⁸ *In the Matter of Request of Lockheed Martin Corp. & Warburg, Pincus & Co. for Review of the Transfer of the Lockheed Martin Commc'ns Indus. Servs. Bus.*, Order, 14 F.C.C. Rcd. 19792 (1999).

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Individual TSPs and TSP affiliates shall be limited to less than a 5% equity ownership interest in NeuStar. In the event any TSP or TSP affiliate acquires any ownership interest in NeuStar in violation of this limit, NeuStar may not register these shares and no voting rights may be granted to such shares. TSPs and TSP affiliates may not cure any excess interests by placing them in the Voting Trust. This requirement will help minimize the risk that entities with a vested interest in the outcome of numbering administration activities will be able to exert undue influence over NeuStar. Furthermore, limiting the level of TSP or TSP affiliate equity interests will help minimize the risk of any industry segment exerting undue influence over NeuStar.⁹

It seems simple: no telecommunications service provider can own more than 5 percent of Neustar *and* a voting trust may not be used to cure an interest of a TSP that exceeds that 5 percent threshold. The valid basis for this rule is to prevent undue influence by TSPs and to ensure that no industry segment—such as, for example, the wireless industry—could have undue influence over the LNPA. The same rule set must be applied to Telcordia, and a voting trust is therefore not appropriate in these circumstances.

In addition, voting trusts “should be employed only where necessary, and then in as limited an extent as possible.”¹⁰ In previous cases, the Commission has relied on voting trusts knowing that the trusts are “short-term and that the stations will be ultimately sold to third party buyers.”¹¹ Here, there can be no showing that the voting trust is either necessary, or limited in duration. In fact, the voting trust will remain necessary for the length of the Telcordia five-to-seven year contract. The voting trust would also not be necessary if Telcordia were spun off from Ericsson as was required of Neustar, or if the Commission awarded the LNPA contract to Neustar, a company that has complied with critical neutrality requirement of section 251(e) and the Commission’s rules.

The remainder of the LNP Alliance’s meetings were focused on the need for an extensive transition period with exhaustive testing and a better understanding of the costs for small to medium-sized carriers of the LNPA transition. As to the former, in order to meet homeland security and national security concerns, Telcordia has committed that it will not be using any of the code that they have deployed in their implementing LNP in foreign countries and will be

⁹ *In the Matter of N. Am. Numbering Plan Admin. Neustar, Inc.*, Order, 19 F.C.C. Rcd. 16982, 16991, ¶ 22 (2004).

¹⁰ *In Re Applications of Shareholders of Amfm, Inc.*, Memorandum Opinion and Order, 15 F.C.C. Rcd. 16062, 16073 ¶ 26 (2000).

¹¹ *Id.*

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creating new code for the NPAC from scratch. In addition, there has never before been an NPAC/LNPA Transition so this will be a first-of-a-kind project that will need exhaustive testing over an extended period of time.

As Chairman Wheeler recognized yesterday in the context of Senate Commerce Committee questioning on delays in the spectrum auctions, when implementing new systems from whole cloth and particularly when those systems involve writing new code, it is critical to have the appropriate testing structure established. The Chairman's comments that the spectrum auctions were delayed by six months because there needed to be more extensive testing of brand new code is directly relevant here. New code never works the first time and competitors such as the members of the LNP Alliance need assurances through Commission transition and testing requirements that porting and routing will work smoothly. It also speaks to the critical need for regression testing of all LSOA and LSMS software—the systems used by carriers to access the NPAC—deployed by all entities with interfaces to the NPAC database. An extensive transition period of two years or longer is particularly important in light of the fact that, like the spectrum auction referenced by Chairman Wheeler, the LNPA/NPAC transition is a first-of-its-kind endeavor that has never been tried.

The industry also needs assurance that the cost for all carriers to receive information from the NPAC database and to populate the NPAC database with information, regarding the attributes of a telephone number is wholly contained and fully described in the LNPA agreement, and is further controlled as a “shared cost” under 47 C.F.R § 52.32 regardless of whether service for the number is provided using TDM or IP technology. The industry also needs to know what the costs are for small carriers to complete the transition to a new LNPA. The Commission needs to require that such costs will be nondiscriminatory and will not impose an undue burden on smaller carriers that have a limited capacity to absorb additional costs. *See* attached LNP Alliance Conditions.¹²

The LNP Alliance agrees with the recent recommendations of the New America Open Technology Institute (“OTI”) that the Commission should appoint an independent LNPA transition manager to certify that costs for small and medium-sized carriers are reasonable and that the full range of services will be provided at the same level of quality by the new LNPA as by the prior LNPA.¹³ This is a critical commitment and the Commission, and transition

¹² *See also* Letter from James C. Falvey, counsel to The LNP Alliance, to Marlene H. Dortch, Secretary, FCC, CC Docket No. 95-116, WC Docket No. 09-109 (Mar. 12, 2015).

¹³ Letter from Michael Calabrese, Director, Wireless Future Project, Open Technology Institute, New America to Marlene H. Dortch, Secretary, FCC, CC Docket No. 95-116, WC Docket No. 09-109, at 3 (Mar. 16, 2015).



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manager, must ensure that there is no backsliding in this regard. The LNP Alliance also urges the Commission to ensure that there is a transparent and open process going forward. We agree with OTI's recommendation that the negotiated contract and its scope of work be put out for public notice and comment.¹⁴ We also urge the Commission to provide public input and insight into the negotiation of the LNPA contract in as many ways as possible. The current proposal to turn the negotiation over to the NAPM would not provide the requisite public input. The Commission could require FCC staff participation in the negotiations or periodic public reports and workshops on the progress of the negotiations in order to ensure an open and transparent process.

As required by Section 1.1206(b), this *ex parte* notification is being filed electronically for inclusion in the public record of the above-referenced proceedings. If you have any questions or require additional information, please do not hesitate to contact me at 202.659.6655.

Sincerely,

/s/ James C. Falvey
James C. Falvey
Counsel for The LNP Alliance

Enclosure

cc: Commissioner Ajit Pai
Commissioner Michael O'Rielly
Daniel Alvarez
Amy Bender
Nick Degani
Rebekah Goodheart
Travis Litman
David Simpson
Lisa Gelb
Ann Stevens

¹⁴ *Id.* at 4.

EXHIBIT A



LNP Alliance Concerns with the LNP Selection Process:
Neutrality, IP Transition and the Need for a Two-Year Delay
CC Docket No. 95-116; WC Docket No. 09-109

March 17, 2015

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Consultant
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LNP Alliance Members

- The LNP Alliance is a consortium of small and medium (“S/M”) providers comprised of Comspan Communications, Inc., Telnet Worldwide, Inc., the Northwest Telecommunications Association (“NWTa”), and the Michigan Internet and Telecommunications Alliance (“MITA”)
- The LNP Alliance is focused on ensuring that the LNPA selection process takes into account the concerns of its S/M provider members and other similarly situated providers
- The LNP Alliance is concerned about the risks and costs to S/M providers which still have not been clearly defined

Why is the LNP Alliance concerned about the LNPA Selection Process?

- NPAC is critical to all porting and routing of calls/texts.
Failure or errors impact customers
- S/M carriers were not represented on the SWG
- Short transition interval (July 1, 2015 start date) doesn't allow for extensive pre-testing before launch
- Dual system—overlap period during which both Neustar and Telcordia must operate—during transition creates costs for S/M carriers
- No information as to what costs S/M will bear
- System and interface changes create costs and resource burden on carriers
- How can S/M carriers budget for and recover such costs?

IP Transition Task Forces Have Not Defined the Role of the NPAC

- The IP Transition is ongoing but the future role of the NPAC has not yet been fully determined. There are at least three industry task forces—the ATIS/SIP Forum IP-NNI Task Force, the ATIS Industry Numbering Committee, and the Internet Engineering Task Force—considering the role of the NPAC
- Role of NPAC will not be fully defined until their work is completed. Contract must include all requirements.
- Telcordia and Neustar had a very different understanding of the role of the NPAC post-IP Transition when they bid on the LNPA contract, and were **not** submitting comparable, “apples to apples” bids
- There is no detail in the North American Portability Management (NAPM) Request for Proposal (RFP) about what the role of the NPAC will be post-IP Transition

Telcordia Sees Limited Role for NPAC

- Based on May 2014 Telcordia White Paper, Telcordia envisions a limited role for the NPAC.
- Telcordia intends to create ENUM registries, which would be private databases that would compete with the NPAC.
- Telcordia has also outlined in public filings in 2009 the manner in which the LNPA could execute a successful “anticompetitive monopoly leveraging and cross-subsidization strategy with respect to the ENUM services market” (May 22, 2009 Letter at 5).
- The Commission should be very concerned about Telcordia leveraging its NPAC monopoly into the ENUM services market.
- The Commission should ensure that Telcordia is ***prohibited*** from offering ENUM services if it takes over the NPAC.

Telcordia/Ericsson does not meet the Commission's neutrality requirements

- The FCC's rules and the RFP emphasize the critical importance of having a neutral Local Number Portability Administrator (LNPA):
 - The LNPA cannot be affiliated with a telecom equipment manufacturer (47 C.F.R. § 52.26(a));
 - The LNPA cannot be aligned with a particular industry segment (47 C.F.R. § 52.12(a)(1));
 - The LNPA must be impartial (47 C.F.R. § 52.12(a)(1)), independent (47 C.F.R. § 52.21(k)), and not subject to undue influence (47 C.F.R. § 52.21(a)(1)(iii)).
- Telcordia, as a wholly owned affiliate of Ericsson, a leading wireless equipment manufacturer, cannot meet this test.
- Sprint has outsourced its network operations to Ericsson, and Ericsson also has significant managed services agreements with T-Mobile and Clearwire, now part of Sprint, to run their networks.
- Ericsson is also negotiating managed services agreements with Verizon Wireless and AT&T Wireless.
- Ericsson and its Telcordia affiliate are clearly aligned with the wireless industry.

Telcordia is not neutral due its LSMS/SOA, LERG and BIRRDs presence

- Telcordia is the leading provider of the Local Service Management System (LSMS) and Service Order Administration (SOA) systems that providers use to access the Number Portability Administration Center (NPAC), which is administered by the LNPA.
- Telcordia cannot be impartial or independent and could leverage its LNPA monopoly to expand its presence in the LSMS/SOA market (*e.g.*, by providing faster response times to and from the NPAC for customers using Telcordia LSMS/SOA systems).
- LSMS is the system owned by a service provider and which receives data broadcast from the NPAC/SMS. The LSMS provisions the service provider's downstream systems, such as its LNP call routing database. The LSMS is a mechanized system used primarily to receive data broadcasts from the NPAC/SMS.
- Telcordia also runs the LERG and the BIRRDs databases.

Telcordia Must Be Spun Off from Ericsson, LSMS/SOA, LERG and BIRRDs

- **Solution:** *The Commission should ensure that Telcordia is spun off from Ericsson* and separated from its LSMS/SOA, LERG and BIRRDs lines of business before being considered as the LNPA. It must also not be permitted to enter the ENUM registry services market, as discussed below.
- Having a separate board of directors does not begin to solve the problem because Telcordia's current advisory board is comprised of wireless industry executives.

Two-Year Extension Needed in Light of Neutrality and IP Transition Concerns

- *The Commission should extend the Neustar contract by two years* so that industry task forces can define the future role of the NPAC *before* providers are asked to bid on the LNPA contract
- There is not enough time to implement LNPA transition without serious complications before June 30, 2015
- The RFP should be amended to establish specific requirements for the services expected of the LNPA so all parties will be bidding on the same requirements
- Extension would allow time to address neutrality concerns, separating Telcordia from Ericsson and from LSMS/SOA and BIRDS

Growing Support for Two-Year Extension

- There is a growing drumbeat of voices from a variety of perspectives that support delaying the decision on the next LNPA.
- On August 7, 2014, Reps. Mike Rogers (R-Mich.) and C.A. "Dutch" Ruppersberger (D-Md.), the Chairman and ranking Democrat of the House Intelligence Committee, in a letter to Chairman Wheeler, urged the FCC to consult the FBI and other security agencies before picking an LNPA vendor.
- Chairman Rogers is concerned that the selection process "will not adequately address the inherent national security issues involved in this database."

Law Enforcement and 9-1-1 Interests

Have Raised Concerns

- The FBI, DEA, Secret Service, NYPD, Chiefs of Police, and National Sheriffs Association have all expressed concerns about their need for specific outputs from the NPAC/LNPA.
- The Oklahoma PUC, NENA, Intrado, TCS, and the Illinois Emergency Management Association have raised concerns about 9-1-1 updates based on the NPAC/LNPA.
- Seven-state April 2014 9-1-1 outage, affecting 81 PSAPs and 6,600 failed emergency calls, highlights need to get transition right.
- These key participants have been on the outside looking in and like S/M providers, are concerned that critical issues may not be addressed in the LNPA transition.
- S/M provider cost, IP Transition and neutrality concerns, combined with national security, law enforcement and 9-1-1 related issues ***all point towards the need for the Commission to extend the Neustar contract by two years.***

Need for Greater Transparency

- Recent Neustar Petition for Declaratory Ruling focused on FACA and the need for greater transparency and broader participation in the process
- Less than a third as many SWG participants as in 1997
- Smallest carriers are Level 3 and XO, each with billions in revenue
- Lack of participation by S/M providers and other interested national security, law enforcement and public safety parties have left many on outside of the process concerned about how the transition to a new provider would affect their interests

Mishandling LNPA Selection Process

could lead to . . .

- Significant adverse customer impacts
- Adverse impact on competitors and competition
- Adverse impact on the IP Transition
- Interruption of critical emergency services
- Failures of network security
- Given what's at stake, a two-year extension is required to "get it right"

EXHIBIT B

List of LNP Alliance Proposed Conditions on Telcordia Contract Award
(CC Docket No. 95-116; WC Docket No. 09-109)
March 17, 2015

If the Commission decides to award the LNPA contract to Telcordia, we urge you to include the following conditions in that decision:

- Understanding that the LERG only contains routing information for number blocks originally assigned to the requesting provider, the industry needs assurance that all information necessary to successfully route and establish a session (*e.g.*, a telephone call) in native format to a ported number is wholly and completely contained within the NPAC database record for that number, regardless of whether service for the number is provided using TDM or IP technology. This would eliminate the possibility that non-neutral ENUM registries would impose unforeseen costs and/or processes on smaller carriers.
- The industry needs assurance that the cost for all carriers to receive information from the NPAC database and to populate the NPAC database with information, regarding the attributes of a telephone number is wholly contained and fully described in the LNPA agreement, and is further controlled as a “shared cost” under 47 C.F.R § 52.32 regardless of whether service for the number is provided using TDM or IP technology.
- The industry needs to know what the costs are for small carriers to complete the transition to a new LNPA and the Commission needs to require that such costs will be nondiscriminatory and will not impose an undue burden on smaller carriers that have a limited capacity to absorb additional costs. *See* above concerning the need for an RFA.
- The industry needs assurance that the methods and procedures necessary to access and to populate the NPAC database information for numbers where service is provided using both TDM technology and for numbers where service is provided using IP technology are fully described in the LNPA agreement.
- The industry needs assurance that comprehensive testing methods for service assurance, along with recommended timeframes for testing, are outlined in the LNPA agreement. These timeframes must be sufficient to provide adequate time for the comprehensive testing that is necessary to ensure that future porting and routing will not fail. Testing must be concluded by the new LNPA prior to cutover for numbers where service is provided using both TDM technology and for numbers where service is provided using IP technology.
- Telcordia should not be permitted to provide LSMS/SOA services and those services should be spun off by Ericsson to another entity that is not controlled by Telcordia.
- The Commission should require Ericsson to spin off Telcordia from Ericsson. We have not seen any other public proposal that would provide the neutrality required by the

Commission's rules. Ericsson will continue to rely heavily on telecommunications equipment sales and will literally run the networks of at least two major wireless providers so Telcordia cannot have a relationship with this parent company without violating the Commission's rules.¹

- If the Commission is going to institute a voting trust, the details should be made publicly available for public comment, including the percent of ownership controlled by the voting trust. The voting trust representative should be named by the Commission and not by Ericsson. And the Commission should not permit exceptions for decisions on which the voting trust will not be permitted to vote because a voting trust is already a weak and inadequate solution to Telcordia's lack of neutrality. Ericsson cannot have it both ways: it cannot continue to make independent corporate decisions on key issues such as a merger or sale of Telcordia or issuing debt, while still claiming that Telcordia will be independent and neutral. What better way to put pressure on the voting trust than to threaten actions over which the trustee has no say due to the voting trust exceptions.

The LNP Alliance looks forward to continued dialog with the Commission through a public and transparent process as to the details of the transition to a new LNPA administrator if such a transition is to take place. If you have any questions about the above list of conditions, please do not hesitate to contact Jim Falvey at 202.659.6655.

¹ See, e.g., 47 C.F.R. § 52.26(a); 47 C.F.R. § 52.12(a)(1); 47 C.F.R. § 52.21(k), and 47 C.F.R. § 52.21(a)(1)(iii).

EXHIBIT C

IP Inter-Carrier Routing

Capabilities to Support IP Services Interconnection

The Need for IP Interconnection

Service providers have been transitioning their individual networks to IP for many years. The industry has now come to a critical point where key decisions and capabilities are required to support IP based interconnection, and thereby enable growth of wide-scale and end-to-end IP services. The industry has been exploring ENUM based telephone number registries for a number of years and although not deployed, these experiences will be useful as the industry begins to conceptualize the future IP 10-digit line level database. A number of initiatives have recently been created to take the transition to all-IP networks to the next step.

It should be noted that ENUM has found a niche to determine a unique Service Provider ID (SPID) for routing SMS (short message service) and MMS (multimedia message service) over IP, but ENUM is not yet used in the US for the exchange of routing data between service providers to support real-time IP services on a nationwide scale.

Key market drivers are the ongoing deployment of LTE, and the need to provide interoperability, roaming, and IP based interconnection for the new Voice over LTE (VoLTE) and High Definition (HD) voice services that are being launched worldwide.

The GSM Association (GSMA) and the i3forum recently launched an IP interconnection initiative to drive the deployment of VoLTE and new high quality IP communication services through commercial pilots with leading mobile and fixed providers including Deutsche Telecom, Vodafone, Orange, and Telefonica.

In the US, the FCC is driving towards the sunset of the PSTN and has launched a set of service based experiments and data collection initiatives aimed at evaluating the impacts on consumers and businesses of replacing the existing copper-based telephone network with IP based alternatives for broadband, video, data, and voice services. The challenge is to support secure, reliable, and innovative communications services while ensuring public safety, widespread and affordable access, competition, and consumer protection.

Part of this challenge is to enable open access to IP services from a large number of providers to encourage innovation, competition, and a wide array of choice for consumers and businesses.

Enabling IP Interconnection

Although converged communication in an IP environment has long been a prevailing catchphrase in the telecommunications industry, there have been many roadblocks to achieving seamless interoperability between service providers that the industry is now starting to address.

In addition to the GSMA, i3forum, and FCC initiatives mentioned above, ATIS, the North American organizational partner for 3GPP, and the SIP Forum announced a joint task force in

January 2014 to fully specify an IP communications Network-to-Network Interface (NNI) between North American service providers. The goal is to ensure all service interconnection between providers can occur at the IP level end-to-end, including wide-scale IP-based voice services and other ubiquitous advanced real-time communications such as high-definition voice, point-to-point video calling, and multimedia text across wireless, wireline and cable providers.

Although telecommunications users are identified in different ways for different services (e.g., telephone number, email address, internet domain name, location routing number), telephone numbers remain a ubiquitous mechanism for subscribers to find each other. ENUM (E.164 Number mapping) enables participating service providers to map subscribers' phone numbers to a variety of IP attributes and services. A registry service that enables this mapping is an important element of IP intercarrier routing.

Any registry service that provides these mappings also needs to provide three essential capabilities:

- **Policy** - allows trusted interconnect partners to share certain interconnect and routing information with each other to obtain interconnect and routing data. This can be accomplished during the provisioning process.
- **Rules** – provide the ability to aggregate the telephone numbers into a grouping, e.g., OCN, NPA-NXX, LRN, etc., or assign different attributes to a telephone number. This functionality occurs within the registry and the results of the “rules” are either provided in the download to each operator or by per session query.
- **Peering** - allows for multiple registry providers to synchronize with each other and offer the same authoritative data to their respective customers. Enabling competition amongst registries will ensure a more resilient and innovative service with market based pricing

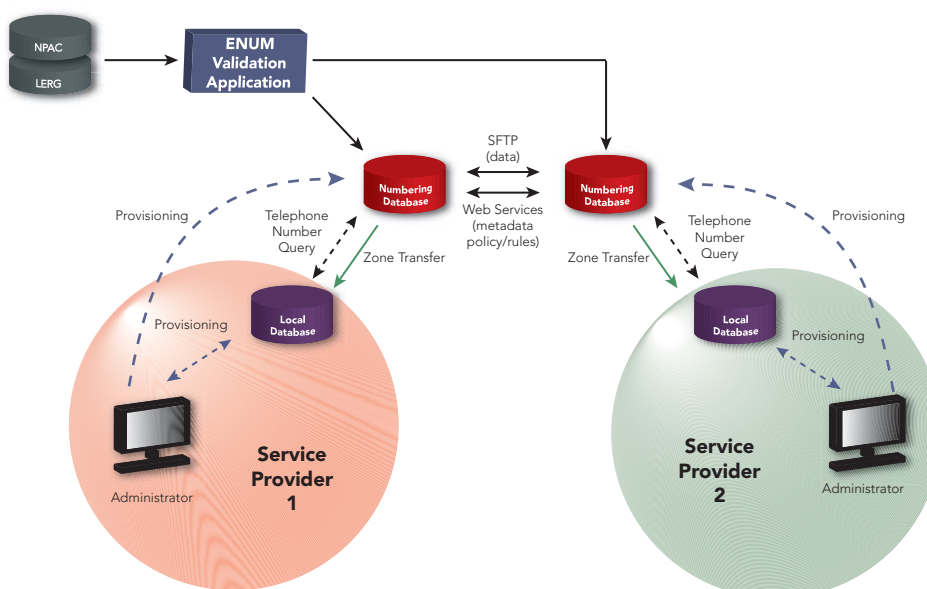


Figure 1 - Peering Registry Reference Architecture

Figure 1 is a reference architecture of the registry that depicts the mechanism by which information is provisioned, distributed, and how multiple registries can co-exist.

IP Interconnection Registry Policy

The US industry is driving towards IP interconnection on a nationwide basis. Unlike the legacy PSTN where the originating network determines the route, IP interconnection may have different characteristics compared to TDM. For example, service providers will be responsible for getting traffic to and from aggregation points where it will be exchanged with other carriers. This would require that an IP Interconnection Registry not only support the interconnection points but also understand, acknowledge and honor the commercial interconnection agreements between service providers.

In an all-IP environment the Service Provider that provisions the data will also likely define one or more selective lists of Data Recipients so that data is not given to unauthorized parties. Therefore, service providers determine the content of the Name Authority Pointer (NAPTR) records returned in response to ENUM queries, including the Uniform Resource Identifier (URI) information that specifies how IP sessions should be routed. Similarly, the Business Logic provisioned by the Service Providers determines the contact information in Session Initiation Protocol (SIP) messages returned to SIP Proxies so that calls can be routed using SIP signaling.

Another example of policy would allow for different Name Server records; depending on the originating & terminating service provider combination, the registry could be configured with policy for source based resolution using a "Recipient Group" feature. For example, some authorized Service Providers of Record might input Name Server information for the same TN that in one case refers to the Tier 2 Name Server of a transit operator or Internetwork Packet Exchange (IPX) and in another case refers to their own terminating Tier 2 Name Server when they are peering or interconnecting directly with the originating service provider. While more powerful in the Tier 2 Name Server platform, this feature has potential application at the registry level and could be used for either per session queries as well as to customize the data download to local cache.

IP Interconnection Registry Rules

The number of records stored in an IP Interconnection Registry could be tens or hundreds of millions based on the need to assign different characteristics per TN. A single change can ripple through the data and touch a vast number of records. As Service Providers provision their Destination Codes, such as Telephone Numbers (TNs), Local Routing Numbers (LRNs), 1K NPA (Numbering Plan Area)-NXX-X number pool blocks, or 10K NPA-NXX exchange codes, these records would identify a routing pattern. A rule that aggregates a number of TNs into a block such as NPA-NXX or NPA-NXX_X can dramatically reduce the number of records that need to be provisioned because it enables higher-level groupings that provide a compressed record set.

For example, an NS or NAPTR record value could be assigned to each Operating Company Number (OCN) rather than to each telephone number or, to each unique Service Provider ID (SPID) and/or NPA/NXX or Location Routing Number (LRN). This could also differ by TN and be at the discretion of the number holder.

As the migration to IP occurs, a single telephone number may be associated with several services, e.g., HD voice, Instant Messaging (IM), and IP telephony. Consequently, when a telephone number is dialed, the service provider needs to know how to route the call. In the example of HD voice (using G722 or G722.2 codecs), if an end user calls from a HD device and

the call is terminated on a HD device, the quality of the call should not be downgraded to traditional voice (G711). The issue is that not all border gateways/session border controllers are HD-capable and not all service providers are HD-capable and consequently this becomes a question of capital investment. The originating service provider should have the ability to route the call to an HD-capable gateway all the way at the far end. However, if the terminating network cannot complete the HD session, then there is no reason to use the more expensive HD codecs. Therefore, the network needs to associate that destination number with some "HD capable" flag.

Not all subscribers have the same services. Therefore, the calling network needs to determine whether the called party has the requested service prior to setting up the call. A solution would be to publish the service information for end users in a registry. A purpose-built registry can accommodate various service attributes at a TN level as well as at coarser levels based on rules established by the Service Provider. The use of rules allows the industry to provision services against higher levels of abstraction which optimize the number of records in the registry and especially in a local (cache) database. Every record and every digit used to identify the record(s) could drive increased costs across the industry.

The registry could optionally be used by service providers to capture and exchange NAPTR records instead of just NS records thereby combining Tier 2 functionality in the Tier 1 Registry. This would limit the number of external cross network queries. This could be optional according to terminating service provider discretion and would be transparent to the originating service provider. This would enable ENUM implementation without the complexity of cross network queries.

IP Interconnection Registry Interworking

Another issue to address is the examination of the often-heard statement that there can be "no more than one National ENUM Registry" because of synchronization issues.

The situation with operating multiple ENUM Registries is different than that of operating a distribution infrastructure, such as the Domain Name Server DNS (A.ROOT-SERVERS.NET through M.ROOT-SERVERS.NET), since these Registries are assumed to be independently managed by competing organizations, each of which allow changes to be made to data. Unlike the DNS system, there is not a single source of valid data. It is important to be clear that each of the competing Registries is intended to contain the same data. The issue, then, is to create an architecture that allows propagation of changes with high speed and high precision, to achieve sufficient synchronization capability such that the information within each registry is identical over a sufficiently rapid time scale.

One obstacle to achieving synchronization is the quantity of data involved. The number of records stored in a registry could be tens or hundreds of millions. Clearly, the time taken to distribute a large number of changed records puts a lower bound on the time scale over which the Registries can be considered to be synchronized. However, it is often not necessary to distribute the changed records explicitly. The simple change which impacted the vast number of records can be described by an equally simple rules statement, which can then be compactly and quickly distributed. It is necessary only that:

- Each registry includes a policy language and rule set that operates on the data's metadata, unambiguously and completely describing the changes
- Each registry uses the same policy language in conjunction with the established rules to describe changes sent and to interpret changes received

Figure 1 is a reference architecture of the proposed solution, consisting of multiple peered Registries combined with either cached data in each Service Provider's environment or allowing a query per session.

This figure shows the overall solution, in which the Service Providers provision data in their registry of choice. In addition, the Registries also receive Industry Data from the Number Portability Administration Center (NPAC) and Local Exchange Routing Guide (LERG). The Registries stay in sync by means of two mechanisms: File Transfer Protocol (FTP) and Web Services.

The FTP-based component relies on a file naming convention and an agreed-upon directory structure which is consistent over all participants. The file names contain an identifier for the intended recipient and a timestamp. In addition, the files are named either ALL or INCR. The INCR (Incremental) files contain only changes to data made during the last hour, whereas the ALL files are a dump of the entire database, written every 24 hours. Each file contains a Transaction ID which acts as an index to the stream of changes. Files are written by the sending registry to the FTP site and pulled by the receiving registry as desired.

In addition there is a Web Services component which provides near-real-time response. Each registry commits to exposing changes on the Web Services interface within a matter of seconds, and other Registries poll the interface as often as desired, typically every 15 seconds. Each Web Services query specifies a Transaction ID, so that the server knows the starting point from which changes are required for that specific query. Each response to a Web Services query specifies a "next" Transaction ID which will be used in a subsequent query. Thus there is assurance that every change is transmitted in a stream of linked queries and responses.

It is assumed that the Web Services client will continually poll the server, but if for some reason the client goes silent for some time, the stream is not broken. All that happens is that the next query after a long hiatus will receive a long response.

The Web Services mechanism is well-suited to transmitting relatively small messages on a rapid schedule, such as the rules declaration messages referred to above. The FTP mechanism is well suited to transmitting large numbers of explicit changes by "brute force" if required. This is primarily intended to be a mechanism used during startup or recovery, but a convention might be that ALL explicit data is transferred via Secure FTP (SFTP) (regardless of quantity) and the Web Services mechanism is ONLY used for rules declarations.

Of course some changes are more compactly described by sending the actual data, rather than forcing it into a contrived rules-based description. Thus a convention would be needed to distinguish actual changed data from rules statements which describe changes if Web Services are used to carry both.

In addition, the possibility of collisions must be considered, in which two independent changes are made in different Registries within the synchronization timescale. Each registry must be prepared to roll back changes if it receives instructions from another registry which impact a

datum which has just been changed locally.

As the migration to a service rich IP environment occurs, multiple ENUM registries can co-exist and it is important to enable peering capability. As an example, this overall architecture already exists within the TV White Spaces industry. The Whitespaces Database Administrators (WSDBA) group has defined an architecture and an Interoperability Specification (<http://apps.fcc.gov/ecfs/document/view?id=7520963472>) which allows a number of WSDBAs (several of which are certified by the FCC and actively interoperating) to accept registration information and distribute it quickly and accurately, thereby remaining synchronized.

Summary

As more and more telecommunications services are designed for, or migrate to, IP (e.g., VoIP, VoLTE, high definition voice, messaging, and M2M communications), an authoritative means for identifying telecommunications users and services reachable via IP will become a prerequisite to operate at scale. A platform for provisioning and exchanging this interconnection information between telecommunications providers is needed.

Although telecommunications users are identified in different ways for different services (e.g., telephone number, email address, internet domain name, location routing number), telephone numbers remain a ubiquitous mechanism for subscribers to find each other. ENUM has been used in telecommunications for many years but now needs to evolve to meet the particular needs of inter-carrier routing. As the breadth of available services increases, a standards-based mechanism will be needed for mapping a telephone number into IP addresses designating service-specific interconnection points. This capability will be required as part of any large-scale, service-rich IP interconnection architecture. A trusted, centrally-managed IP interconnection registry for inter-carrier routing of IP enabled services should provide three essential functions; policy during the provisioning process, rules based on routing granularity, and the ability to support multiple competing IP interconnection registries. These practical enhancements to today's ENUM solutions will enable the industry to manage inter-carrier routing on a nationwide scale and ultimately sunset the PSTN.